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ATHANASIUS KIRCHER'S MAGICAL INSTRUMENTS

An Essay on 'Science', 'Religion' and Applied Metaphysics

Abstract

In this paper I endeavour to bridge the gap between the history of material culture and the history of ideas. I do this by focussing on the intersection between metaphysics and technology - what I call 'applied metaphysics' - in the oeuvre of the Jesuit scholar Athanasius Kircher. By scrutinising the interplay between texts, objects and images in Kircher's work, it becomes possible to describe the multiplicity of meanings related to his artefacts. I unearth as yet overlooked metaphysical and religious meanings of the camera obscura, for instance, as well as of various other optical and magnetic devices. Today, instruments and artefacts are almost exclusively seen in the light of a narrow economic and technical concept. Historically, the 'use' of artefacts is much more diverse, however, and I argue that it is time to historicize the concept of 'utility'.

Keywords

Jesuit science, utility, material culture, history of ideas, magnetic theology, light metaphysics, camera obscura, technological expressionism, philosophy of artefacts.

> ‘via the Jesuit Telegraph, *they* enjoy their d———’d Marvel of instant Communication,’— far-reaching and free of error, thanks to giant balloons sent to great Altitudes, Mirrors of para- (not to mention dia-) bolickal perfection, beams of light focused to hitherto unimagined intensities,— so, at any rate, say the encrypted reports that find their ways to the desks of highly-plac’d men whose daily task it is, to make sure they know every-thing,— appropriate to their places,— that must be known.
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> - Thomas Pynchon, *Mason & Dixon* (1997) -

Introduction

If one were transposed to the seventeenth-century museum of the *Collegio Romano*, the Jesuit college in Rome, one would encounter a totally different world: a world stuffed with prodigies, exotic animals, relics, obelisks and bizarre machines. One would enter the fantastic universe of Athanasius Kircher (1602-1680), who was the head of the museum, professor at the college and a famous intellectual and ‘experimentalist’. Some of Kircher’s instruments have already been subject to elaborate scholarly interpretative efforts, but even these, such as the sunflower clock, the magnetic Jesus rescuing Peter in the midst of the waters, and the cats locked into a catoptric chest, still turn our categories upside down and keep defying our understanding. Their utility and the ways to use them are not self-evident; their purposes, their meanings, the ‘language they speak’, are alien to us. Kircher’s artefacts have become ‘unreal’ for us, and in order to understand them, it is necessary to draw on all resources possible. In particular, as I will show, it is crucial to pay attention to the interplay between his texts, objects and images as well as their diverse contexts and uses.[1]

[1] For background on Kircher, see especially the new and excellent introduction by Paula Findlen (Findlen, 2004b), which gives an overview of Kircher’s life and work, and relates the ambiguous attitude of many contemporaries towards him. Luminaries like Peirsec, Mersenne, Leibniz and many other were lured into Kircher’s world and at certain times supported, appreciated or drew upon his work. The literature on Kircher is expanding rapidly. See especially Findlen (2004a), Beinlich (2002), Rowland (2001a), Sardo (2001) and

In this paper, I try to uncover the meanings of Kircher's artefacts by confronting them with hitherto neglected parts of his texts. I focus on the metaphysical epilogues in two of Kircher's books, the *Magnes sive de arte magnetica opus tripartitum* (1641, third edition 1654) and the *Ars Magna Lucis et Umbrae* (1646, second edition 1671), and I establish their relation with the body of the text, with his artefacts and with the practices in which both texts and artefacts were used. Until now, there has been little real interest in this aspect of Kircher's thought, and these abstract metaphysical texts have seemed rather awkward appendices to treatises centred on instruments. Recent developments in the historiography of material culture have yielded important new insights in Kircher's artefacts, natural philosophy and experimental pursuits, but lofty metaphysics seems to be a blind spot for such a perspective. I hope that a slight shift in focus will be able to shed new light on the current Kircher-debate. In particular, I will argue that the meaning of his metaphysical chapters is central to the meaning of his artefacts, and vice versa.

In this paper, I aim at blending the history of material culture with the history of ideas, and I hope to show the fruitfulness of such an approach. This text is thus an essay in 'applied metaphysics' in the simple sense that it relates Kircher's abstract metaphysical considerations to its applications in 'science and technology'.[2] It is also an essay in applied metaphysics as

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Stolzenberg (2001a) for recent scholarly works, often the reflection of a conference or exhibition. See Bartola (2004) and Jäger (2003) for the most recent overviews of the literature. Brauen (1982) gives an outline of the literature till 1980, and gives some idea of the changing appreciation of Kircher through the centuries (Fletcher 1981 and 1988 are also still useful in that respect). See Haakman's (1991) documentary novel on the resurgent interests in Kircher in the 1980s, and especially on the spurious *Internationalen Athanasius Kircher Forschungsgesellschaft*, before the revival of Kircher in genuine international scholarship.

[2] Just like the concept 'science' has been challenged for early modern history (Cunningham, 1988; Cunningham and Williams, 1993), the notion of 'technology' can be questioned as well. Kircher studied many subjects, such as mixed mathematics, astronomy, cosmogony, natural history, natural philosophy, natural magic and artificial magic (see also note 27). Similarly, some of Kircher's 'technologies' were in fact mathematical and natural philosophical instruments; others were part of artificial or mathematical magic. Kircher himself invented many terms to categorise his instruments in more detail. Using the modern concept 'science' would obscure the particular differentiations between these seventeenth-century categories. Furthermore, it might confound our understanding of the distinctive nature of these practices as opposed to modern science (such as the often crucial role of God in early modern natural philosophical thought as opposed to secularised modern science). This paper can be read as providing a similar argument for the concept 'technology'. Where appropriate, however, (to indicate broader historiographical issues, for instance) terms like 'science' and 'technology' can still be used (Jardine, 2000b). 'Religion' too is not an unproblematic historical category and in the course of this paper, the

Daston (2000, p. 1) defines it: 'Applied metaphysics assumes that reality is a matter of degree, and that phenomena that are indisputably real in the colloquial sense that they exist may become more or less intensely real, depending on how densely they are woven into scientific thought and practice.'

'Inter-medial' approaches

The Jesuits have always been fond of mixed media spectacles, from the markedly sensual and visual *Spiritual Exercises* of their founding father Ignatius of Loyola, to the elaborate stage plays they performed in order to retrieve lost souls.[3] The visual culture of the Jesuits and their taste for spectacle is well illustrated by the academic defences at the *Collegio Romano* as described by Louise Rice (1999). The academic defence of a young man was his first public 'performance', which could be crucial in shaping his later career. It was thus important to attract and impress a large and aristocratic audience, which was why these defences evolved into a 'lavish spectacle, theatrical in every sense' (Rice, 1999, p. 158). A multi-media performance, of decorations, allusive music, poetry, and a broadsheet with an elaborate allegorical drawing and written elucidations, accompanied the words spoken by the student. The broadsheet, often designed by the student's professors and executed by skilled craftsmen, was infused with an elaborate play of heraldry and Jesuit symbolism, making cross-references to the accompanying poems and songs. Around 1640, at the height of the broadsheet's popularity, it became more than a metre in size and often took more than a year to produce. At the defence, when the patron of the student was first presented with the broadsheet, 'he had just heard a panegyric in his honour in which the subject and significance of the invention

multiplicity and heterogeneous nature of practices related to (Christian and Catholic) 'religion' will also be underscored.

[3] For the *Spiritual Exercises*, see esp. Ignatius (1991), de Guibert (1964, pp. 109-139, pp. 527-565) and O'Malley (1993, pp. 37-50). For Jesuit theatricality, see Valentin (1978), McCabe (1983), Norman (2001), Gorman (1998, ch. 7), Vermeir (2005).

were already spelled out, and even as he studied the image he was listening to a motet, the verses of which provided an ampler explication of what he saw' (*ibid.*, p. 163).[4] The student's philosophical conclusions, in most cases prepared and written down by his professor, seemed to be of secondary importance compared with the elaborate exercise in the rhetoric of praise (which may have been considered to be more useful than the philosophical theses anyway, given the courtly context). As can be seen in *Fig. 1*, the emblematic image usurped almost the whole space on the broadsheet, leaving not much for the words, which had to be crammed at the bottom of the page. What we would today call 'scientific themes' were especially popular in the broadsheets of the *Collegio Romano*, 'geography, cartography, chronometry, optics, magnetism, distillation, horticulture, astrology, and, above all, astronomy receive fanciful treatment in scores of theses,'[5] but these 'scientific elements' were often more connected with symbolism and heraldry than with the contents of the defence. This already shows that something else than modern science was involved. The sun, for instance, could stand for Apollo, the *Seminario Romano*, the glory of a Cardinal, and Divine Wisdom. 'It is all these things, nor are its different meanings in any sense contradictory' (Rice, 1999, p. 163).

This Jesuit academic defence – an ensemble of words, images, music and things, conjoined in a symbolic play – is an interesting instance of word-image-artefact interactions in the Baroque sciences. It is clear that meaning in such a multimedia spectacle does not reside in the text alone, nor in the image, but in the interplay of the different media, when the beholder directs his gaze from text to image and back, while listening to the disputation or the accompanying music.[6] It is in this Baroque Jesuit context that what I would call an 'inter-medial' approach

[4] See also Kircher's musical 'play' in honor of the archduke before the preface of his *Musurgia* (Kircher, 1650)

[5] Rice (1999, p. 151). Some might have been inspired by Kircher's fame, but regrettably, the study of the connection of these broadsheets with their broader mathematical and philosophical context is still underdeveloped.

[6] I am using a theory of meaning (based on Wittgenstein's ideas) in which meaning is generated in specific local practices. In this paper, I show that Baroque Jesuit culture is a fitting starting point and an apt 'local context' for discovering the diverse meanings of Kircher's instruments. I do not assume, however, that Baroque Jesuit culture is a homogeneous unity and I make clear in the course of this paper that it combines a multiplicity of different practices.

(which should be common historiographical practice) takes on a special import, because this context was characterised by a particular rhetoric and epistemology which drew heavily on analogical techniques. The meaning of a text fragment, an image or an artefact is always determined by its broader context, but this insight is much more important if a text, image or artefact is part of a complicated web of analogies and hidden references. As I will indicate below, these analogical techniques reached an apex in Kircher's work.[7]

The appearances of Kircher's *Ars Magna Lucis et Umbrae* and *Magnes sive de arte magnetica opus tripartitum* are not unrelated to those of the examined broadsheets (although the words still have the upper hand in Kircher's books), and both show in an exemplary way how the Jesuits were skilled in interweaving meanings through different media. The merging of 'scientific' and symbolic elements, the importance of the elaborate and expensive illustrations, the profuse presence of heraldry and courtly politics, the theological and metaphysical aspects, the use of allegory and emblems, as well as the interplay between visual and textual languages are particularly striking. The respective frontispieces (*figs. 5* and *6*) already suggest these complex relations. In order to show how these frontispieces are related to the body of the work, I will give a brief overview of both the *Magnes* and the *Ars Magna*.[8]

[7] Kircher often uses analogy, combinatorics, metaphor and ideas of harmony to connect a very diverse set of ideas and objects. See e.g. Leinkauf (1993, pp. 161-190) for Kircher's analogical and combinatorial method. Bach (1985, pp. 131-194) and Leinkauf (1988) discuss Kircher's method in general. See also Schmidt-Biggeman (1983) for the general context of the methods used to build universal sciences. Lacking from these discussions, however, is the religious tradition of the uses of analogy. The Bible itself is full of metaphors and parables. See de Lubac's (1959-1966) and especially Brinkmann's (1980) standard works on modes of scriptural interpretation. See also Brisson (2004) for neo-Platonic symbolism and myth interpretation in relation to scriptural interpretation. Of course, there existed other (albeit sometimes related) kinds of symbolism and modes of secrecy, present in magical traditions, for instance. In early modern Europe, also hieroglyphs were considered symbolical, which meant: 'Of the symbolical, one sort directly conveys its meaning by *imitation*; another sort is written as it were *metaphorically*; while the remaining sort speaks *allegorically* as it were by means of aenigmas' (A passage from Clemens of Alexandria, quoted in Horapollo, 1840, pp. 169-170). In Kircher's case, these techniques are particularly prominent because he consciously adapted many different traditions as regards analogical reasoning (e.g. the Christian allegorical tradition, Lullism, Platonic analogies, Pythagorean harmony theory, Cabbala).

[8] Different overviews of the general contents and structure of Kirchers *Ars Magna* can be found in Bach (1985), Cassanelli (1986), Ianniello (1986), Chevalley (1987) and Corradino (1993). For the *Magnes* and magnetism, see Hine (1982), Baldwin (1987), Hine (1988) and Baldwin (2001).

Word and image

The *Ars Magna Lucis et Umbrae*, Kircher's magnum opus on light and shadow, is divided into 10 books, which are meant to correspond to the 10 *Zephiroth*. These are, according to the Cabbala, the 10 mystical stages in the emanation from God.[9] Kircher also calls his books the 10 strings which make up the universal harmony, the *Harmonia Decachordi*.[10] After the enumeration of the chapters, he concludes with a quotation from Psalm 134: '…in decachordo psalterio psallam tibi' (for you, God, we play on a ten-stringed cithara). The structure of Kircher's book thus follows the structure of the universe, and if we let these chapters 'sound' simultaneously, if we relate their different styles and subjects, we might hear something of the universal harmony.[11]

Kircher's *Ars Magna* deals with all kinds of knowledge related to light and shadow, most prominently optics and gnomonics. The first two books of the *Ars Magna* are rather theoretical. The first considers the nature of light, shadow and colours, together with the structure of the sun, moon and planets. The second book elaborates a general theory of radiation, after the paradigm of light and optics,[12] by which many natural effects, such as

[9] Kircher (1671, *Ad Lectorem*). The oeuvre of Gershom Scholem and Moshe Idel has excellent accounts of the Cabbala. For the Zephiroth, see Scholem (1978, p. 96). The theoretical foundation of the Cabbala was largely influenced by Neo-Platonism and its theory of emanation. In Kircher, we find a new mix of these traditions. In the *Ad Lectorem*, the metaphysical epilogue is equated with the Cabbalist *Ensuph*, the infinite and inexplicable God from whom the ten Zephiroth/chapters emanate. Traditionally, the tripartite Cabbalist *Ensuph* resembled the Christian trinity and was also explained by means of light metaphors (Scholem, 1978, pp. 88-96).

[10] After the table of contents, he summarizes the structure of the book: *Harmonia Decachordi, sive idea operis decupartiti*.

[11] It is at first difficult to see these assertions as something more than empty rhetoric, attempting to appropriate subjects like applied mathematics, natural philosophy and artificial magic to a religious framework. Kircher's work is full of ambiguities and there is no obvious relation between these metaphysical precepts, the ordering of the book and the metaphysical and structural elements in his other work (the chapters do not correspond in an evident way to the 10 *decachords* or *enneachords* of the *Musurgia Universalis* (Kircher, 1650, synopsis and II pp. 392-4), for instance, or to the 10 'Zephiroth' in the *Magnes*). Nevertheless, Kircher makes many cross-references throughout his works, connecting different disciplines by means of analogies and discussing the same theories or objects in different contexts. Also the structural similarities between magnetism, light, musical harmonies and mathematical properties were crucial for Kircher.

[12] See e.g. Lindberg (1976, pp. 94-103) and Lindberg (1983, pp. xxxv-liii) for such theories. Roger Bacon and Grosseteste, who are the focus of Lindberg's discussion, are not mentioned by Kircher however. Kircher rather

sympathy and antipathy, are explained. Instruments such as the camera obscura and perspective devices are also touched on. The other books of the volume are filled with directions for constructing all kinds of instruments. Books 3-6 deal primarily with clocks, but also with astrolabes and horoscopes. Books 7-8 are on 'reflected' and 'refracted astronomy' respectively (but clocks still loom large),[13] book 9 discusses distances and heights (and instruments to measure them), and book 10, the *Magic of Light and Shadow*, deals with the hidden effects of light and shadow and their many applications, containing the most curious devices such as fantastic clocks, metamorphoses-machines (deforming the reflected images of the spectators in different ways) and instruments for a new cryptology. The work ends with a metaphysical epilogue.

The *Magnes*, Kircher's great work on magnetism, is in many ways similar to the *Ars Magna*. The book is subdivided into three parts: (1) on the nature and properties of the magnet, (2) on its applications in astronomy, natural magic, geography, navigation, etc., and (3) on its hidden workings throughout the world. This third part is divided into 10 sections, which are again associated with the 10 branches of the Cabbalist Zephirotic tree (Kircher, 1654, p. 613).[14] The ten sections of part three deal with the magnetism of the earth, the planets, the stars, the elements, the different parts of the earth, the tides, the plants, medicine, music, love and God. Sometimes, the same instruments are described in both the *Magnes* and the *Ars Magna*, suggesting their interrelatedness. In fact, light and magnetism could be considered similar,

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refers to Aristotle, Witelo, Alhazen and Lucretius in his discussion of rays, and to Aguilon and Plotinus in his discussion of colours.

[13] 'Reflected' and 'refracted' astronomy refer to astronomy practiced by means of mirrors and lenses respectively, or to the study of cosmological phenomena related to reflection and refraction respectively. The former includes sections on the influence of reflected moon rays on the climate on earth, reflection clocks and astrolabes; the latter includes the study of atmospheric refraction and discussions of refraction astrolabes and clocks.

[14] Godwin (1979, p. 74) also discerns its Zephirothic structure in the antiporta frontispiece of the 1654 edition of the *Magnes*. Kircher later published a small derivative work on magnetism (Kircher, 1667), with yet another symbolical frontispiece. This work was divided into three parts (on the magnetism of inanimate, vegetal and sentient natures), a 'trinity' which was reflected in the make-up of the frontispiece.

because each is in itself invisible but has visible effects (light is even the cause of visibility).[15] Their powers are 'occult', which made them pre-eminently suitable for constructing wondrous instruments, because the non-mechanical and non-manifest working principles of such instruments would increase the puzzlement of the spectators even more. According to Kircher, light and magnetism also share many analogical applications and metaphorical meanings.

Kircher's texts are very diverse in topic and style. Notwithstanding the luxuriousness of the editions, Kircher aimed at a diversity of readers from all over the world, and his diversity in style invited different modes of reading.[16] His theoretical sections contain classical learning as well as the newest discoveries; in his sections on instruments, construction instructions are interspersed with anecdotes, emblems and indications of possible contexts of application; and his metaphysics is meant for a public steeped in theology, Neo-Platonism and Hermetic philosophy. The shifts in different styles and expected modes of reading is tailored to a diverse public, including nobles, courtiers, mathematicians, natural philosophers, experimental philosophers, instrument builders and artisans connected to the courts (because of the price of the books), members of religious orders, theologians, wealthy students etc. Also the use of his figures is varied, as can be seen in his use of diagrams, tables, and schemes. He chose rather schematic figures for his 'naturalistic' representations of astronomical objects, and his more detailed depictions of the moon's surface were crude

[15] See e.g. Kircher (1671, p. 691): '… quam magnetici radii habent ad lucidos radios affinitatem, & analogiam,…' assuming the link to be already evident. See also the associations in the epilogues and introductions in both books, such as the explanation of the title of the *Ars Magna Lucis & Umbrae*: '*Magnam* dicimus, ob occultam quandam ad Magnetem allusionem.' Kircher (1671, *Ad Lectorem*).

[16] In a letter to his publisher, Kircher states that his Jesuits network distributed his books over the whole world (including Africa and the Americas) and indicates the number of copies for the different countries. Kircher to Joannes Jansson van Waesberghe, no place, undated (draft), APUG 561, f. 079r, ID 1428. For the reception of Kircher in the New World and in China, see section V in Findlen (2004a). On Kircher's publishers, there is some information collected in a (curious) volume by Hein (1993). On the publishers van Waesberge, who had an exclusive contract with Kircher since 1661, see van Eeghen (1960-1978, IV, pp. 153-167). Probably, this exclusive contact has deeply affected Kircher's scholarship and publishing strategies (cf. Fletcher, 1986, p. 137). For a short description of Kircher's books with some bibliographic information, see Merrill (1989). On books and patronage in a Jesuit context, see Baldwin (2003).

copies of Francesco Fontana's moon maps. His images were even more stylised when the aim was not to describe but to point at structural characteristics, employing the characteristic faces of sun and moon, as in his drawings of the cast shadows of the planets.[17] Mathematical diagrams alternated with depictions of instruments, but there was an enormous variation in the style of the latter. Some were simple and schematic woodcuts, others were elaborate etchings, often full of symbolic and heraldic meanings (*Fig. 2* versus *Fig. 3*). Some of these were assembled on a white background, stressing their artificial or schematic character, sometimes accompanied by a disembodied eye to indicate their use (*Fig. 4*). Others were presented in a landscape or were part of a broader setting, sometimes giving a naturalistic impression, sometimes stressing the unnatural character of the device, which is presented floating in front of the picture (*Fig. 3*).

By rendering his instruments in so many different ways, Kircher appealed to a diversified readership and claimed authority in many realms. His abstract depictions could appeal to a public of mathematicians, while images rendered in a more concrete fashion might persuade potential instrument builders and should provide them with more details. Kircher also tried to convince his readers of the reality of some of his artefacts by depicting them in meticulous detail in a particular setting. Some of his figures claim authority or objectivity by following certain pictorial conventions, others are clearly meant to gratify or should be seen as an alignment with the religious or political opinion of his supposed readers. It is clear from *Fig. 3* for instance, that he attempted to gratify his patrons by means of embellishments and emblematic references. Kircher's figures invite as many kinds of spectatorship as his texts invite modes of reading.

[17] For Kircher's picture of the moon, see Kircher (1671, pp. 9-10); for the stylised images, Kircher (1671, pp. 3, 6). On Kircher's borrowings from Fontana and other selenographers, see van de Vyver (1971).

The artefacts

Kircher's museum at the *Collegio Romano*, a 'theatre of nature and art' (De Sepibus, 1678, frontispiece), contained many of the instruments described in his books. The extant descriptions of his museum give us some insight into the nature of the collection, which included not only several kinds of clocks, ingenious fountains, barometers, burning mirrors, perspective machines and anamorphoses, but also perpetual-motion machines, optical tricks, a mermaid's tail, the bones of a giant and a host of other natural and artificial marvels.[18] Some of his instruments had obvious uses: some had practical utility, such as the clocks or land surveying devices; others were useful for mathematical research and experimental practice, such as his machines to measure the distance between sun and earth. Kircher usually explained the uses of the instruments described in his books, and it is obvious that some of his measurements are the result of his own application of them. Some of his devices were more ambiguous however. Kircher's portable inclinometer, for instance, was too fragile to survive long voyages and was not really useful, despite Kircher's claims to the contrary (Baldwin, 1987, p. 257). The *depiction* of the inclinometer in Kircher's books (See ***Fig. 7*** and Kircher 1654, pp. 307-311), however, might have been more instrumental because it visualised the need for a community of natural philosophers sharing data on a worldwide scale. Kircher's illustrations of perspectival devices ***(Fig. 2)*** might have been purely pictoral instruments, as they could not have been used as they were drawn. Massey (2003) has argued that many

[18] Kircher often describes in his books the instruments of his museum and extols them above those in other collections. We cannot be sure, however, that all his illustrations had an equivalent in his museum, and if so, they did not necessarily look the same. The relation between description, illustration and artefact is complex and depended on the production process, on the patron and on the aim of the author. Concerning Kircher's artefacts, there are (aside Kircher's own texts) several catalogues or descriptions by his pupils (Schott, 1657; Schott, 1667; Kestler, 1680; Buonanni, 1709; De Sepibus, 1678), visitors' reactions in letters, descriptions in travel guides, and documents of experiments and discussions evoked by these instruments. On Kircher's instruments, see esp. Gorman (2001) and Hankins and Silverman (1995). For Kircher's musical instruments, see Gouk (1999, *passim*) and Gouk (2001). On Kircher's museum, see Casciato, Ianniello and Vitale (1986), Findlen (2003), Sardo (2001) and Bartola (2004). For the tradition of artificial marvels ('artificial' or 'mathematical' magic), see Zetterberg (1976). For the context of musea and collecting in seventeenth-century Italy, see Findlen (1996).

drawings of perspective machines were meant to *show* what perspective was, as a visual aid to the theory, and were not really representations of artefacts to be used by artists.

Other instruments have to be interpreted in the light of the inter-medial spectacles already mentioned. Kircher's museum was also aptly called a 'theatre'. It was a place where his collection was shown and demonstrated to the courtly visitors; it was a 'tourist attraction' for those visiting Rome, and many prominent figures from all over the world were lured into paying Kircher a visit. Even the instruments with a practical utility were now embedded in a context of Baroque spectacle, in which natural objects, artefacts, texts and images were employed for the divertissement of the public. Kircher even staged real shows, which were so amazing that he was sometimes accused of sorcery. It is this particular context and 'use' of his instruments, which constitutes their meaning. Kircher characterised his magical instruments as serving both entertainment and utilitarian purposes,[19] and indeed, relating his devices to the courtly culture of wonder and illusionism explains a good deal; but even granted all this, a lot of mystery remains (cf. Vermeir, 2005).

According to our present-day judgement, many renaissance and early-modern instruments could never have 'worked', and it remains puzzling why they were invented, drawn and sometimes even made. One might explain away Leonardo's 'proto-aircrafts' by taking them as immature attempts at constructing a device for flying, but this is more difficult with the perpetual motion machines that were actually demonstrated. Some of Kircher's instruments did not 'function' either, frustrating those who tried to construct them after the descriptions and images in Kircher's books.[20] It is clear that even pragmatic notions such as 'utility', 'to work' and 'to function' have to be rethought if we want to grasp the meaning of Kircher's

[19] E.g. Kircher (1671, p. 734) writes in his section on 'catoptrical magic': 'Invenientur hic, sive usum publicum, sive privatam Principum recreationem spectes, innumera a nemine, quod sciam, hucusque tradita.'

[20] See e.g. Gorman (2001, pp. 24-25; and 1998, ch. 7). An example is Westleius, a Nuremberg optician who had spent more than thousand pounds in unsuccessful attempts of replicating some of Kircher's 'optic speculations' (Gorman, 1998, p. 225).

instruments. Even if such instruments were only meant to be shown off, it remains a question *what* was meant to be shown.

Hankins and Silverman (1995, pp. 14-36) have tried to explain Kircher's aim in building and demonstrating instruments that could not possibly have 'worked', such as his sunflower seed- and magnetic clocks, stating that Kircher wanted to 'illustrate' (by trickery) the effects of a natural celestial magnetism.[21] Other Kircherian instruments are baffling because of their seemingly religious contentiousness. What are we to make of an illusory resurrection or ascension of Christ devised by optical trickery? (Kircher, 1671, p. 781) How should we interpret his kites in the form of angels, to be used on Ascension Day (Kircher, 1671, p. 724)? What about his staging of a whale, swallowing Jonas by magnetic means (Kircher, 1631, p. 50 and 1654, p. 265), or a mechanical clock, sounding every half hour the tune of the Maria hymn *Ave Maris stella* (De Sepibus, 1678, p. 3)? Or consider a machine consisting of a large crystalline globe full of water representing the resurrection of the Saviour in the midst of the waters (*Ibid.*); or a Christ walking on water, and bringing help to Peter, who is gradually sinking, by a magnetic trick. Kircher also explains this trick: 'A strong magnet must be placed in Peter's breast, and the hands of Christ, stretched out to come to the rescue, or any part of his toga turned toward Peter should be made of excellent steel, and you will have everything required to exhibit the story […] This will happen with greater artifice if the statue of Christ is flexible in its middle, for in this way it will bend itself, to the vast admiration and piety of the spectators'.[22]

[21] Kircher stated that he had made a clock with a sunflower, by propping it up a big piece of cork. After putting it in a basin of water, the sunflower was unhampered in following the course of the sun, and indicated the time on a surrounding scale. Kircher also made clocks with sunflower seeds only. These clocks also worked if the sun was behind the clouds, Kircher claimed, because the sun attracted the flower and its seeds by a celestial magnetic power. For other assessments of Kircher's magnetic and sunflower clocks, see Bedini (1969), Fletcher (1970), Drake (1967), Baldwin (1987, pp. 221-228) and Hine (1988).

[22] Kircher (1631, p. 51) (see also Kircher 1654, p. 265): 'In pectore Petri ponatur validum magnetis fructum, manus vero Christi ad succurrendum extensae aut qualiscumque togae pars, Petrum respiciens ex optimo chalybe confectae sint, & habebis omnia ad historiam exhibendam requisita. […] quod maiori artificio fiet si statua Christi in medio fuerit flexilis, sic enim incuruabit sese summa cum intuentium & admiratione, & pietate.'

As unsuspecting readers, used to twenty-first century modes of religiosity, we can easily sympathise with Michael John Gorman's question: 'How could Kircher dare to make a joke of the central mystery of Christianity? How could he place the resurrected Christ in a glass sphere, alongside genies, water-vomiting snakes and pagan Goddesses?' (Gorman, 2001, pp. 26-7). Notwithstanding the success of an inter-medial approach in placing many of Kircher's artefacts in their proper context, some of his instruments remain puzzling. Even if we are aware of a context characterised by Catholicism and by a preference for spectacle, even if we know how the objects functioned and how they were 'used', our confused response to these artefacts indicates that we still lack any clear sense of their 'meaning'. It will turn out to be necessary to cast our net wider and to bring in an analysis of Kircher's metaphysics.

Metaphysics

In both *Ars Magna* and *Magnes*, the body of the text, with its descriptions of mathematical and natural philosophical theories and instruments, is framed by a metaphysical frontispiece and a metaphysical epilogue.[23] This prominent placing at the beginning and end suggests that the whole work has a metaphysical bearing. The frontispiece of the *Ars Magna* shows the emanation of light from its divine source (symbolised by the tetragrammaton) to the world, linking God with the instruments that receive the light *(Fig. 5).* God is the source of the divine light, which is not directly visible (the clouds) but radiates downwards to the sublunar. Only the nine orders of angels are in direct contact with God, but together with the clouds, they obscure the divine light. The different kinds of background (a division between backgrounds

Kircher (1654, p. 360) claims that Caspar Ens (1636, pp. 117-120) had copied some of his ideas from Kircher (1631), which indicates that Kircher's machines were also popular in the context of mathematical recreations.

[23] For background on Kircher's metaphysics of light and magnetic theology, see Marquet (1983), Bach (1985, pp. 275-305), Baldwin (1987, pp. 453-464) and Leinkauf (1993, pp. 324-342). See Benz (1970) and Fara (1996, pp. 185-193) for eighteenth-century instances of the use of electricity and magnetism in religious metaphors and theological discourse.

is clearly visible between the peacock and the eagle) distinguish between the archetypal, sideral and sublunar spheres. The male figure at the left, blazing with rays of light or fire, symbolises the sun. The signs of the zodiac are painted on his body, a classical way of representing the Zodiac man and the microcosm-macrocosm relationship. He also holds Hermes' rod with the signs of the five planets inscribed between the circular twists of the two snakes and with the 'vivifying eye of heaven' on top. The dark female figure at the right represents the 'lunar mirror'. She holds a staff with Minerva's owl (the animal of dusk and night) and is 'pregnant with the stars'.[24]

Both the sun (symbol of Phoebus-Apollo and Hermes as well as of God, Christ and the Angels) and the moon (Phoebe, the virgins Mary, Artemis-Diana and Athena-Minerva, as well as the Angels and Man), flanked by a two-headed eagle and peacock respectively (symbols of the Habsburgs and optics)[25] take a prominent place in the heavens. They send and reflect light to the earth, which is received by measuring instruments (a moondial and a 'mirror-dial' in a grotto – cf. Kircher (1671, p. 555)). A landscape with a sundial (time measurement), a garden (generation) and ships (navigation), displaying the benefits derived from light, are depicted in the background. Behind all this, the rainbow symbolises the (luminous and colourful) bridge between heaven and earth, the covenant between God and man (Gen. 9:12-16). Although the divine light can only be perceived on earth through the

[24] Much of this symbolism derives from Ficino's text *De Sole*, to which Kircher's metaphysics of light was greatly indebted. For the 'vivifying eye of heaven' and the 'lunar mirror', see Ficino (1959a, pp. 968, 967 respectively). Referring to the Hymns of Orpheus, he also writes that 'The Sun is the eternal eye that sees all things' and 'The Moon is pregnant with the stars; the Moon is queen of the stars' (*Ibid.*, p. 968). The Zodiac man is a traditional medical-astrological image representing the influences of the heavens on the different parts of the body. On a more general level it symbolises the microcosm-macrocosm connection. Ficino (*Ibid.*, p. 968) writes: 'so the virtues of all heavenly things are brought down to the limbs from the Sun via the Moon, to be nurtured through medicines ritually prepared at that particular time' (see also Ficino's *De Vita Libri Tres*). The zodiac is the path of the sun trough the heavens and Ficino's (1959a, p. 966) statement 'Through the twelve signs of the zodiac, it [the sun] is called living' might be an additional explanation of the signs of the zodiac on the sun's body.

[25] Hermes slew the vigilant and sharp-eyed Argus, who had to guard Io from the amorous Zeus/Jupiter. In order to honour him, Hera/Juno transposed Argus's hundred eyes to the peacock's tail (Ovid, 1994, p. 52). The peacock came to stand for optics and enhanced sight. The story is beautifully rendered in Rubens' *Juno and Argus* (1611), a painting which is claimed to illustrate the optical theories his Jesuit friend, the Antwerp mathematician François de Aguilon, later expounded in the latter's *Opticorum libri sex* (Aguilon, 1613; Parkhurst, 1961, pp. 45-46).

various reflections and refractions displayed in the frontispiece, it is clear that natural philosophical and mathematical pursuits here on earth are intimately linked with metaphysics and theology. Kircher also visualises the four sources of knowledge, sacred authority (with divine illumination), the eye of reason (with intellectual illumination), the senses (symbolised by the telescopic projection of physical sunlight on a page, the standard way to observe the sun) and profane authorities (with a little illumination from a lamp), and he gives them their proper place in the cosmic hierarchy.[26]

The frontispiece of the *Magnes* shows the divine eagle, holding up the entire cosmic system and/or body of knowledge, with theology on top *(Fig.6)*. The Judeo-Christian God was often associated with an eagle (in the Torah and the Bible, e.g. Deut. 32, 11) and he sometimes assumed the symbolism of Jupiter, His pagan equivalent. The chains symbolise the hidden magnetic interactions and equivalences between the disciplines (cf. the *decachord* in the *Ars Magna*), and connect them to the microcosm and the sideral, sublunar and archetypal worlds, in the middle of the frontispiece.[27] These chains refer to the magnetic rings in Plato's *Ion*, which symbolise the divine inspiration transmitted by poets to their interpreters and spectators (Plato, 1997, pp. 941-943), as well as to the traditional theme of the great chain of being (cf. Lovejoy, 1936).[28] The banner states 'Omnia nodis arcanis connexa quiescunt' (all things linked by arcane knots are at rest), and suggests that the arcane magnetic forces hold everything in harmonious equilibrium according to the divine plan. The divine hands hold the chains which connect worldly and divine power (crown and imperial globe) symbolised by palm branches (faith) and swords (power). On top of these two chains, the inscription 'occult

[26] Bach (1985, pp. 197-207) provides us with the first coherent attempt of interpreting some of Kircher's frontispieces in their context. More on the tradition of the four sources of knowledge can be found in Ashworth (1989).

[27] The mentioned disciplines are: theology, philosophy, physics, poesis, rhetoric, cosmography, mechanics, perspectives, astronomy, music, geography, arithmetic, natural magic and medicine.

[28] It might also refer to Augustine's (1955, XXI, 4) description of a magnetised chain, which was later interpreted in a devotional way, and to Thomas Aquinas' (1953) *Catena aurea*.

power' on a magnetic stone identifies the nature of the bond, relegating the power of the Holy Roman Emperor to a 'magnetic' interaction.

The epilogue of the *Magnes* examines the source of all magnetic interaction, being the foundation of the 'magnetic chain' that connects everything in the 'theatre of nature'. Everything emanates from the universal nature God, 'the central magnet of all things'. It is then diffused by means of divine rays, from which the order of the created universe springs (represented in the 10 sections/*Zephiroth*).[29] This 'central Magnet' is identified with the divine Trinity: its *attractive* power with the Father; its *ordering* capacities with the Son (the Word or Wisdom); and its connective power with the Holy Spirit (divine Love). These powers are of course never really separable, constituting a tripartite unity.[30] Then the different stages of the emanation are explored in both directions. The ascending movement passes from the first form, through the intermediary elemental, mineral, vegetable, sensible, imaginary, rational, intellectual stages, to the divine Mind and Wisdom, both source and pole of attraction of the whole movement. It is the divine Wisdom that exerts a magnetizing attraction for man's disquieted soul.[31]

Kirchers metaphysics of light, expounded in the epilogue of the *Ars Magna* (*Epilogus, sive Metaphysica Lucis & Umbrae*), is similar but much more complex. Here, Kircher could rely on a long tradition of light metaphysics, and his explanations, excursions and analogies

[29] On God as the central magnet, see Kircher (1654, table of contents): 'Deum rerum omnium centralis magnes'. On the emanations, the magnetic chains and the *Zephiroth*, see Kircher (1654, p. 613). The use of the magnet as a metaphor for God and divine love, and even the first onsets to a 'magnetic theology', can also be found in other seventeenth-century works. See especially Fludd (1638, pp. 250r-250v), Ward (1640), Boyle (1659, pp. 103-105), Silesius (1675, II.2, III.132, V.130); and Hale (1695). Kircher's *Magnes*, however, is the most powerful exponent of this tradition. Kircher's other works on magnetism also conclude with reflections on the divine magnet (Kircher, 1631, pp. 61-63; Kircher, 1667, pp. 129-130).

[30] In order to exist, every being has need of such a tripartite magnetic principle: 'Unde omnis res, ut habeat esse, & tale esse in quo est, opus habet unitrino principio magnetico attrahente, disponente, & connectente.' Kircher (1654, p. 614) This can be interpreted to correspond with the three parts of the *Magnes*: 1. explanation of the essence and power of the magnet, 2. applications or ordering, 3. the connective/magnetic chain.

[31] Kircher (1654, p. 615): 'Mirum non est, si in omni humanae vitae conversatione anima inquieta, nullo alio nisi in ipsa quiescere possit, ex qua, in qua, & per quam omnis illa, quam desiderare homo potest, felicitas est, unicum desiderij sui complementum, principium, medium, & finis. Ad hunc igitur aeternitatis Magnetem uti omnia, ita potissimum mens nostra, ceu ferrum ad magnetem, a quo vitam meret, & gratiam, beatitatemque, ardentissime fertur.'

became more diversified.[32] God is now identified with an infinite incorruptible light, from which everything comes into being. This metaphysics is based on the authority of *Prisca Theologia* and Platonist philosophers, but Kircher asserts that the Christian Theologians adapted these theories to the 'sacrament' of the Trinity. Subsequently, Kircher identifies the Father with the infinite eternal Light (the sun's natural and invisible fecundity), the Son with the emission of this light (the manifest light and its radiation and brilliance), and the Holy Spirit with the heat produced, which nourishes the whole universe with its warmth. The sun is the *visible symbol* of this invisible 'tripartite' Light. Again, different grades of being are discerned, emanating from this original Light (equated with the 'Archetypal world', the Platonist world of ideas, and with the 'Paternal abyss'), each of which retains some of the original light, causing the chain to fade gradually into darkness.[33]

After identifying the original Light with the Trinity, Kircher cites the creation story of the *Pimander* (this is Ficino's translation of the *Corpus Hermeticum*, a Hellenistic compilation of texts thought to be written by the Ancient sage Hermes Trismegistus).[34] Because of the incorrect dating of the *Corpus Hermeticum*, these allegedly pre-biblical semi-Christian revelations from the time of Moses assumed great authority, notwithstanding their sometimes

[32] Kircher does not name his direct sources, but I think that his metaphysics of light is most indebted to Bovillus' *Liber de intellectu* and *Liber de sapiente* (Bovillus, 1510, esp. pp. 3r-8r and 139v-145v) as well as to Ficino's *De Sole* and *De Lumine* (Ficino, 1959b) and other Ficinian works. Also the influence of Pseudo-Dionysius, Hugh of St. Victor and Cusanus looms large. In a more remote way, Kircher is indebted to a long tradition figuring luminaries like Plato, Proclus, Plotinus, the *Corpus Hermeticum*, the Chaldean Oracles and the Orphic Hymns, but also more recent authors such as Scotus Eriugena, Patrizi, Lefèvre d'Etaples and Fludd. For more general discussions of the tradition of the metaphysics of light, see esp. Hugedé (1957), Hedwig (1980), Lindberg (1986) and Scheuerman-Peilicke (2000).

[33] The idea of 'vestigia Trinitatis', the traces or footprints of the Trinity that one could find all over the created world, was part of a long tradition. See e.g. Augustine (1968, VI, X.12), Hugh of St. Victor (1879c) and Bovillus (1510, pp. 134r-136v), who argued that signs of the Trinity can be found everywhere in nature. Also Kepler (1604, p. 6), who is more respected as a 'scientist' today, believed just like Kircher that the nature of light expressed the Divine Trinity.

[34] The theology of the ancient wise men was thought to prefigure Christian theology. These *Prisca Theologia* could not have been rescued by Christ, and could not have perceived revealed truth. On the other hand, since the original knowledge from before the flood got corrupted during the ages, their ancient wisdom and knowledge contained many truths that were obscured in later times. Following on the work of Frances Yates (2002), a whole debate on 'Hermetism' and 'Hermeticism' has ensued, and the influence of Hermetic texts (in contrast to Neo-Platonic and other texts, for instance) on the development of science and on Renaissance culture in general has often been overstated. For a critique of the concepts 'Hermetism' and 'Hermeticism', see e.g. Copenhaver (1988, pp. 83, 93, 96 n.27) and Copenhaver (1990, p. 289).

unorthodox character. Although the dating was corrected by Isaac Casaubon in 1614, Kircher chose to ignore this in order to create a unified picture of an 'original' and pure religion, based on ancient Hermetic and Egyptian (hieroglyphic) sources.[35] In the creation story in the *Pimander*, Christian and Gnostic elements are merged: the creation originates in the interaction between Light and Darkness, and the Son is identified with the 'craftsman' or demiurge who shaped the universe; man too is granted creative powers and becomes a magus-craftsman. Notwithstanding his interest in and sympathy for artificial magic, Kircher avoided the heterodox passage on the demiurge in his discussion and interprets the threefold movement in this creation narrative as the Trinity. Kircher struggles to give an orthodox presentation of Hermes, and tries to relate light and darkness in an abstruse way, by describing the progressive unfolding of the light, which checks itself before emanating again; it radiates and recoils, with the surrounding darkness as its frontier. All these characteristics are related to the properties of physical light, and for Kircher, this theological significance legitimises 'optics' as a subject of elaborate study.

Light metaphors were abundant in the Christian tradition, particularly in Augustinian light-epistemology and Christian mysticism, but also in the Bible (notably Paul and John) and the writings of the Jesuit founding father, Ignatius of Loyola. In Kircher's text, references to these traditions are intermingled with Aristotelian, Platonic and Hermetic elements, and this mix leads to terminological obscurity and ambiguities in classifications. His text constantly shifts almost imperceptibly between physics, cosmogony, cosmology, epistemology, eschatology, metaphysics, mysticism and theology. Although useful for analytical reasons, these distinctions are misleading since all these strands are inseparably intertwined in Kircher's metaphysics of light. Both theology and cosmogony, for instance, are phrased in terms of the

[35] See esp. Eco (1993, ch. 7) and Stolzenberg (2003) for Kircher's studies of the hieroglyphs. Kircher differed in his use of the Hermetic philosophy from Bruno in his belief that these languages and images were not to be used as magical symbols, but he treated them as expressions of religious and metaphysical convictions. Kircher condemned the practice of most forms of magic, except of course natural and artificial magic. Astrology and alchemy were restricted within narrow limits.

spherical propagation of (physical) light from a point-source (cf. *Fig. 9*). His neo-platonic metaphysics of emanation, divided into emanation, receiving and returning, has also a moral and eschatological significance, because it is the goal of all beings to ascend this scale of perfection.[36] This is also the scale ascended by the mystics to attain a *visio dei*. A notable aspect of his metaphysics is his identification of angels and man with mirrors and lenses, which reflect or refract the divine light downwards to the earth.[37] The phenomenal world is then full of shadows, reflecting only other reflections, in which every original is lost. As Paul already wrote: 'For now we see through a glass, darkly; but then face to face' (1 Cor. 13,12). Indeed, the ascent to God by means of contemplation is also a luminary process, according to Kircher, but it is hampered by shadows and distortions of the intermediary angelic mirrors (since during our earthly life, God cannot be seen directly).

The continuous ambiguity in Kircher's descriptions allows him to integrate different traditions in what I would call a 'unity without unification', and it also allows him to draw schemes of correspondences, without having to worry much about consistency. The *Tropologia Lucis & Umbrae*, the last section of the book, placed after the metaphysical epilogue, well illustrates this.[38] Kircher starts off again with the famous Hermetic characterisation of God, the Light, as the 'mystical sphere', of which the circumference is nowhere and the centre everywhere. The Trinity is again evoked and the Zodiac is characterised as the twelve emanations of the divine virtues or attributes. Then, the creatures are revealed to be the shadows of the clothes of God, as Rambam (Maimonides) teaches, and the mystical meanings of planets and Zodiac are

[36] See Kircher (1671, p. 809), where pious souls are propagated in straight lines (cf. light) to God. See also Kircher (1654, p. 616), where is explained that impure iron (souls) is not attracted by the magnet (God). In classical bible hermeneutics, four levels of meaning were distinguished: 1. literal meaning, 2. a deeper epistemological meaning (allegorical and mystical), 3. a deeper moral meaning (tropology), 4. an eschatological meaning (anagogy). Tropological and anagogical metaphors and analogies should guide the faithful in the practical aspects of their life and in their search for salvation (e.g. by giving rules, or by encouraging imitation and meditation).

[37] A similar view can be found in Bovillus (1510, pp. 7r-7v and 140r-140v) already. Bovillus (1510, p. 7r) also explains that material mirrors and material light are signs or symbols of immaterial mirrors and light. See also e.g. Hugh of St. Victor (1879a, pp. 995a-c) for man as a mirror. Such views legitimise the assignment of metaphysical meanings to Kircher's actual mirror-devices (Vermeir, 2005).

[38] For the notion of *tropologia*, see note 36.

explored. The Sun, for instance, is identified with the Sacrament of the Eucharist, the light of the sun is the divine splendour of the militant Church (of which the characteristics are explored), but in the end 'the only Sun is Christ, the only moon the Mother of God [Deipara], protectors of this mystical world'.[39]

The abundance and richness of the cosmos, so I presume, does not allow for one coherent classification. Nevertheless, it is clear that Kircher's diversity of metaphors, analogies and characterisations of God and the universe has the advantage of connecting everything in a (magnetic) chain of associations. For Kircher, the metaphysics of light, the theory of universal harmony, magnetic theology or his hieroglyphic theology are all ways to express a similar message.[40] The radiation of light from a point-source is more suited to express an emanation, and illumination metaphors have always been popular in epistemology and mysticism. The magnet, on the other hand, is outstanding for symbolising the divine love and attraction. Kircher's aim to construct a unified religion, based on the old wisdom of the *Prisca Theologia*, also resulted in the patching together of so many traditions, concepts and terminologies. Kircher's account of Chinese culture,[41] his elaboration of the story of Noah's Flood, his quest for a universal language and the lost knowledge of the *Prisca Theologia*, his attempts to understand and describe nature as a divine creation, and his various other pursuits also contribute to this overarching aim of a unified religion, and find their legitimation in it. In the abstraction of his metaphysics, and by means of its powerful analogical and combinatory

[39] Kircher (1671, pp. 806-7): 'Per Solem, si quid per aliud, certe luculentur significatur Sacrosanctum Eucharistiae Sacramentum, vena vitae, [...] Quid vero per uniformiter difformem Solis lucem aliud indicatur, nisi huius militantis Ecclesiae divinus splendor [...] Unicus autem Sol Christus, unica Luna Deipara, mundi huius mystici praesides.'

[40] See esp. Kircher (1671, pp. 795-810), Kircher (1650, II pp. 364-462), Kircher (1654, pp. 613-618) and Kircher (1652-1655, II, pp. 497-546) for the respective 'metaphysics' or 'theology'. In the Christian tradition, with its well developed hermeneutical apparatus, both the bible and the world could be read on different levels without any real discrepancy. Therefore, antiquarianism as well as natural philosophy and mathematics could fit seamlessly in a broader metaphysical and theological framework, without precluding diligence and competence in all these areas of scholarship.

[41] It was part of the controversial Jesuit programme of 'accommodation' to integrate Christian practices into traditional Chinese customs and beliefs (cf. the rites controversy). The borders of orthodoxy and heterodoxy were continuously negotiated by the Jesuits, and they were heavily criticised for that by other Christians. One could say that for Kircher, this principle also ranged backwards in time, in order to accommodate ancient Egyptians and other cultures too. On Jesuit 'accommodation', see e.g. Mungello (1985) and Billings (2004).

tools, different kinds of knowledge and divergent religions could be reconciled and merged. Ultimately, this made his metaphysics the focal point of all his other activities.

Utility and entertainment?

The idea emerges that Kircher's oeuvre, this unity without unification, abounds in different ways of proclaiming an overarching message. His use of texts, figures and artefacts all have to be included and integrated to hear his harmonious chord of different meanings – religious, moral, political, philosophical, experimental, technical, artistic,... – working together to fulfil the Jesuit ideology. In an important paper, Harris (1989) has tried to identify this ideology and its interest for the history of science.[42] He stressed the importance of the Jesuit 'apostolic spirituality', the values necessary for an active (apostolic) life in the service to God. A long and exacting period of ascetic and intellectual formation served to inculcate these values, which resulted in a deep sense of commitment to the ideological movement. Harris argued that this also influenced their intellectual beliefs, since their ideas could incorporate and give expression to their ideological values. The result was an 'image of knowledge', which – using a nice Kircherian metaphor – served as a *cognitive lens* that focused and filtered the intellectual energy of the members of the Society (Harris, 1989, pp. 46-47).
All knowledge was assessed on its utility to achieve the Jesuits' religious goals,[43] especially in their three main areas of activity (the 'apostolates'): in education, at court, and in the foreign missions. Every science (*scientia*) had to demonstrate its fitness for, and usefulness to, the Jesuit program. Efficiency and practicality were obvious criteria; but I would argue that

[42] For some recent work on Jesuits and the history of science, see e.g. Dear (1995a), Feingold (2003a), Feingold (2003b), Feldhay (1987), Feldhay and Heyd (1989), Feldhay (1999) and O'Malley (1999a). See O'Malley (1999b) for a recent historiography of the Jesuits.
[43] Harris (1989, note 4): 'Certainly for the first two hundred years of the Society's existence – and probably for its entire existence – one cannot speak of science as an autonomous cultural activity within the Society. Thus we may assume that the methods, practices, and goals of scientific activity within the Society were subservient to its religious program.' See also the conclusion of Hellyer (1999, p. 548).

the full meaning of 'utility' was not so confined. Of course, the Jesuits tried to strengthen their monopoly in education by means of a general focus on knowledge, and their position at court could be ensured by catching the nobleman's attention with wonders (e.g. the *Wunderkammer*, mathematical magic) and useful knowledge (e.g. navigation, fortification). As in secular contexts, the curiosities described or displayed by the Jesuits were often fantastic and had no direct practical use, although the marvellous and claims for utility were frequently intertwined *(Fig. 7)*.[44] For the Jesuits, however, both useful knowledge and the marvellous could only be means to a higher end. Their education served the propagation of Catholic values and beliefs, and although their position at court gave them opportunities as preachers and confessors, their grip on society would be much more successful if the Catholic values and ideas could be integrated with the transfer of (natural philosophical) knowledge and incorporated into their marvellous spectacles. Jesuit mathematics and natural philosophy did not only have a practical function, it had to be in tune with their other values and practices in order to constitute a real 'Christian science'. Although Jesuit investigations into the natural world were not very different from other approaches at the moment – they were widely esteemed as experts in mathematics as well as in natural and even experimental philosophy – their work functioned in a broader program and had additional meanings.

The centre of the Jesuits' project was the battle for minds and souls, and their practical and intellectual pursuits were often a deliberate strategy in this religious program. This evident bias in education and research evoked the criticism of many contemporaries. For the Jesuits,

[44] The 'usefulness' of early-modern instruments was a typical rhetorical trope, but most of the time, these instruments were not 'useful' in our sense of the word. Recent secondary literature has stressed the importance of artefacts and books about technology for the 'moral economy exclusively concerned with exchanges that enhanced the glory and power of the patron and remunerated the client with various material and status benefits' (Long, 2001, p. 243). Pamela Long (*ibid*.) has tried to counter this view and stressed the genuineness and the substantive nature of the knowledge exchanged. Although she is undoubtedly right that we cannot reduce the whole of early modern technology to patronage relations, many instruments remain puzzling, 'unreal' and inexplicable by our modern standards. Many of Kircher's instruments, as well as some examples in her own book, attest of these problems.

both studies and active work were a form of prayer – 'everything is prayer'[45] – and I propose that we see their texts and artefacts literally as 'prayers', as pious contemplations on the world, framed in a religious and metaphysical practice. This explains, for instance, the importance for Kircher of writing a tract on the marvellous appearance of crosses occurring after a volcanic eruption, the *Diatribe de Prodigiosis Crucibus* (1661). Though these signs were natural (instead of miraculous or demonic), Kircher interpreted them as indications of the omnipresence of divine providence. From the Jesuit standpoint, it was important to find the image of a crucified Christ in a stone, for instance, between the numerous other fossils, because it confirmed God's presence in nature. These stones were *signs* placed there for human discovery, evidence of God's revelation in the world.[46] As the Jesuits construed their work as God's work, they created artificial signs themselves, pointing at this divine presence. Also artefacts and new inventions necessarily conformed to the norms and structures of the divine universe. The Jesuits organised theatre plays, re-staging the crucial moments in Catholic history. In a similar way, their artefacts were meant to re-stage the creation, the moral or divine order of the cosmos. These practices, pointing at divine signs, making them explicit and interpreting them, were part of the purpose of their natural philosophical and experimental activities. It was a way of convincing apostates, and of supporting the faithful and glorifying God.

Of course, the Jesuit sciences cannot be *reduced* to religion. Mathematical propositions and experimental setups cannot be fully 'explained' by their religious contexts, nor should we endorse contemporary critiques that Jesuit *scientia* was nothing more than a sneaky way of making proselytes, but these religious and apostolic contexts can nevertheless prove crucial in

[45] Ignatius (1970, p. 184), cited in Harris (1989, p. 51).

[46] For the Christian tradition to read the world as full of divine signs, see Brinkmann (1980). The Trinity had been central to Ignatius of Loyola's spirituality, and he was always on the lookout for signs from God, which had to guide the choices he made. See e.g. his *Spiritual Diary* and his *Autobiography*, especially on the system of 'election' and 'discernment' (de Nicolas, 1986, pp. 47-60, 135-137, 189-197, 253-255). See also note 33 on the 'vestigia Trinitatis'. For the Christian interpretation of fossils, see e.g. Nummedal (2001, p. 41). See also Stolzenberg (2001a) and Findlen (1990) on the plays of nature.

order to understand the full meaning of the Jesuits' pursuits. Furthermore, individual Jesuits differed in their opinion of how scientific exploits could best serve their religious aims and they developed different strategies for serving their order. Kircher's particular approach, for example, was only one (rather spectacular) option in a wide field of possibilities. Therefore, in a similar way, Kircher cannot be *reduced* to his Jesuit identity, although no doubt this identity was fundamental to his work. From very early on, his education had taken place in a Jesuit setting, characterised by the *Ratio Studiorum* and the *Spiritual Exercises*. Patronage relations based on the Jesuit network defined his later career. Kircher's Jesuit identity shaped and permeated his work; it co-determined his institutional setting, his access to rare linguistic and natural philosophical resources as well as many of his doctrinal allegiances. On the other hand, his metaphysical explorations discussed in the previous sections are anything but orthodox, and his works frequently provoked negative reports from the Jesuit censors.[47] These reports, in turn, were often overruled by the Jesuit General, who judged that in this case, doctrinal unity was subservient to the publicity and success realised for the Society by means of Kircher's lavish tomes. Despite the formalised and hierarchical structure of the Jesuits, the Society cannot be treated as a seamless unity.[48] These internal disagreements, as well as Kircher's powerful connections, ranging from Cardinals and Archdukes to the Pope and the Holy Roman Emperor, helped to ensure his success and relative independence as an author.

[47] Despite their controversial metaphysics, the *Magnes* and the *Ars Magna* passed censorship without much trouble. The former received approval from Rethi Baptista (ARSI FG 667 609r) and 'approval with comment' from Giattinus Baptista (ARSI FG 667 610r). The latter received approval from Cripsius Joannes and Rethi Baptista (ARSI FG 667 611r and 612r) and 'approval with comment' from Inchofer Melchior (ARSI FG 667 613r), who had played an important role in Galileo's trial. His later works, however, were more under fire and were often disapproved. Sometimes, the reason was unorthodoxy or unclearness (e.g. his pronouncements on Copernicanism or atomism). More often, however, Kircher was criticised because of his immodesty and because the quality of his works was deemed insufficient. On the Jesuit system of censorship, and on Kircher and his censors in particular, see Siebert (2004) and Stolzenberg (forthcoming).

[48] For the intellectual cohesion of the Jesuit order, see esp. Harris (1989). For the standard Aristotelianism and Thomism in Jesuit education, see Simmons (1999). For Aristotelianism in the 'strange context' of Kircher's work, see Leinkauf (1988). See Feldhay (1987) for Jesuit deviations from traditional Thomism and Feldhay (1999) for reflections on the variety of differentiated positions in Jesuit science.

Nevertheless, Jesuit culture is the most fitting context in relation to which we have to understand Kircher's work, and I think that my interpretation of Jesuit practice, as part of a broader Catholic context, may throw light on some of his instruments that have continued to baffle modern scholars. Some of Kircher's instruments can be elucidated, for instance, by placing them in the context of the Jesuit apostolic mission. Many of his artefacts could be practically employed in convincing and converting people. Take his *parastatic smicroscope*, for example, through which the passion of Christ could be displayed (*Fig. 4*), or his anamorphoses hiding/displaying religious messages. He also made kites in the form of a dragon, with IRA DEI inscribed and covered with sulphur, after which he sent the burning dragon to the heathen in order to frighten and convert them (Kircher, 1671, p. 724). Kircher's books can be read as catalogues and instruction manuals providing the Jesuits with devices for their 'battle of souls'. But not only the artefacts were intended to be useful, the images in the book were also a staging of religious scenes, and were part of Jesuit visual rhetoric. Other artefacts, however, cannot be reduced to a simple display of Catholic 'utility and entertainment', and Kircher's instruments can be found to hide even more layers of meaning. Kircher's mirror spectacles, for instance, are not only entertaining, but can also be interpreted as moral tests, and the perception of layers of different realities hidden behind the veil of everyday phenomena created a vertigo in the religious beholder (Kircher, 1671, pp. 775-788). In his catoptrical theatres, the world became illusory. One became conscious of one's life in the shadows, where one encountered only reflections and never the things themselves. Every reflection was again another step, removing us from the original Light. Even one's 'self' crumbled when looking into Kircher's distorting or scattering mirrors. All sense of place and time was lost. Despair and self-reflection, evoked by mirrors, were preconditions for gaining a religious insight, for a conversion or for an interaction with the other-worldly. Mirrors had also important theological meanings, as can be seen in Jesuit devotional books, and they could

offer a glance at the divine forces behind the visible world. On one of the images in David's *Duodecim Specula* (1610), for instance, two devout people contemplate 'the invisible through the visible' and see God through a mirror *(Fig. 8)*. Parts of Kircher's magnetic theology and metaphysics of light can be read as a commentary on the latter picture: 'in these things themselves, as if they were a kind of mirrors (or lenses), you will see God.'[49] These examples suggest again that in order to understand the meaning of some of Kircher's artefacts, it is necessary to bring in his metaphysics.

Applied metaphysics

Let us now recall those allegedly 'impious' instruments, seemingly desecrating the most holy mysteries: Kircher's devices to create a magnetic and catoptric resurrection, and his magnetic toys re-enacting the rescue of the drowning Peter. Gorman (2001, p. 26), in an otherwise brilliant text, remarks: 'Surely to place the Resurrection in this mechanical context was tantamount to reducing it to a secret combination of natural causes and denying its miraculous status?' The point is, however, that it is not a 'mechanical context' at all, the crucial element being the natural but 'occult' or hidden forces of magnetism and light. Both serve as material symbols of the divine Magnet or Light. The rescue of Peter by Jesus, re-staged by means of iron and magnet, should not be seen as a materialistic profanation. The action of the magnet is a symbol of the divine love and faith, attracting both and binding them together (see also *fig. 11*). In the epilogue of the *Magnes*, Christ's magnetic nature is made explicit: '*When I shall be lift up from the earth, I will draw all things unto myself* [John 12,32]. There is indeed nobody who does not know how this is fulfilled. Because by means of these magnetic strings of the cross, attracted by these fetters, the whole world has followed him presently, and rulers,

[49] Kircher (1654, p. 617), see note 59.

kings, emperors, leaving their sceptres behind, are attracted by this magnet, and disparaging the world, they clung to the Magnet Christ.'[50]

The 'metaphysical' significance of Kircher's instruments can be inferred even better from a section in the epilogue of the *Ars Magna*, where Kircher embarks on a metaphysical interpretation of the camera obscura. The instrument is evoked in the context of the ascent of the soul to God. The soul, 'immigrant' in a lower world, suffers from its impurity. It is lost in this world of shadows and illusions, which confuses and destabilises it. Searching for its lost purity and guided by love ('that Egyptian Demon' as Kircher writes),[51] it will be raised from the lower to the higher. Kircher uses Apuleius' famous tale of Psychè (soul) and Cupid (love) to illustrate this process.[52] The tale describes the ascension of the soul to God, where it is restored and regains its true nature. After this, Kircher embarks on an explanation of this process in terms of his metaphysics of light, but he is conscious of the obscurity of his exegesis, which he tries to elucidate with the example of the camera obscura.

One should carefully observe, Kircher recommends, how the rays of the sun (with its enormous diameter) all pass through a little hole, how a pyramidal cone is formed in which the rays are switched around so that the image of the sun appears inverted on an opposite

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[50] Kircher (1654, p. 616): '*Cum exaltatus fuero a terra, omnia traham ad me ipsum*. Certe quomodo id completum sit, nemo est qui nesciat. Nam hisce funiculis crucis magneticis, hisce vinculis mox totus mundus attractus post eum abiit, hoc magnete Principes, Reges, Imperatores attracti relictis sceptris, mundoque spreto, Christo magneti adhaeserunt.' See also Kircher (1631, pp. 63-65). Interestingly, Ward (1640, pp. 42-48), a puritan preacher in Ipswich, also gives the example of the (magnetic) rescue of Peter, together with other examples of biblical magnetism, in the context of a magnetic theology. He writes: 'these sensible helpes of Faith, are not altogether to be despised, which after their manner and measure, doe further and strengthen our Faith' (Ward, 1640, pp. 44). This already shows that Jesuit modes of religiosity were to a large extend shared by other orders and denominations. Works on the Renaissance tradition of paradox (Colie, 1966), and the tradition of jokes and laughter in Christianity (Screech, 1997), might also help to illuminate the use of such seemingly contentious artefacts. Of course, also mechanical artefacts might, in specific contexts, have metaphysical and theological meanings (e.g. traditional ideas of God as clockmaker, illustrations of God with a pair of compasses). Findlen (2003, pp. 240-255) stresses Kircher's more Aristotelian instruments.

[51] Note that love (best symbolised by the magnet, see e.g. book III,9 of the *Magnes*: 'De magnetismo amoris') plays this crucial role in Kircher's metaphysics of light, which indicates again that his magnetic and light-metaphysics are interdependent. For parallels with Kircher's theory of music, and his use of musical instruments to embody cosmic harmonies, see Gouk (1999, pp. 144-153); see Heninger (1974) for the broader context.

[52] Apuleius (notorious as the alleged translator of the *Corpus Hermeticum*) wrote it as a mirror-tale in his *Metamorphoses*, in which the hero was transformed into an ass and had to endure many worldly tribulations, before being saved. This salvation was a consequence of his conversion to the Egyptian cult of Isis, which coincided with his regaining his human form and dignity (Apuleius, 1989).

wall. The projected disc will become larger, the further the cone is prolonged (by shifting the wall), and to equal the size of the sun, the incoming and outgoing cones should be of equal length. Kircher then explains: 'In a similar way, the influxes of the ideas that are derived from the highest life to the lower, are driven from very small straits into a most particular straitness, until they are reflected by matter and bodies, and are brought back from the singular to the universal in the human souls, to regain their old magnificence.'[53] The image presented here is that of intersecting lines, forming two cones (cones like the one shown in *Fig. 9*, in which some intermediate stadia are visualised). The left side is the divine emanation, the Platonist *eidè* or the Archetypal ideas, which are infused into the world. This narrowing cone represents the descent into the different scales of being, the gradual increase in embodiment and the waning of the divine Light. The intersection point corresponds to pure singularity or materiality. The widening right cone represents the *recollectio*, the return to God, the abstraction and generalisation, in which the soul and the angelic intellect play a crucial role. In this rational and intellectual light, the *eidè* are again abstracted out of the material world, and in this process, the soul can ascend to God (that is why the cones should be of equal length, because the *eidè* have to be fully restored). As can be seen, at first the light gradually wanes into darkness, to disappear at the point of singularity, symbolising pure materiality, to revive again, and to be restored to its original splendour.

This is the core of Kircher's metaphysics of light, embodied in the operation of the camera obscura. This scheme resembles Cusanus' and Fludd's intersecting light cones (Cusanus, 1972, I, ch. 11; and Fludd, 1617, pp. 97, 165), which represent a similar metaphysics, and an image of intersecting cones is reproduced on Kircher's title page, together with a biblical

[53] Kircher (1671, p. 804): 'Ita & idearum influxus a suprema vita in inferiorem derivati, ex angustissimis maxime in angustiam particularem rediguntur, donec a materie, atque corporibus reflexi, iterum in humanos animos ex singularibus facti universales, amplitudine pristina potiantur.' The 'ex angustissimis maxime in angustiam particularem' is difficult to interpret, but I propose to read it as an account of what happens near the hole of the camera obscura, where the rays of light come together, are even further compressed, and all pass through a very narrow hole. On a metaphysical plane, a similar 'compression' would happen with the (archetypal) ideas when they are embodied.

quotation *(Fig. 10)*.[54] The caption 'sicut tenebrae eius, ita et lumen eius' (as is His darkness, so is His light [Ps. 139,12]), is a phrase popular and widely used in mystical texts.[55] In Richard Rolle's (1914, p. 239) *Emendatio Vitae* (*The Mending of Life*), for instance, it is explained with the words: 'The mind's sight is truly taken up to behold heavenly things, yet by shadowly sight and in a mirror, not clearly and openly: whiles we go by faith we see as it were by a mirror and shadow.' In the *Ars Magna*, the emblem represents the interaction between the realm of the light and the realm of shadows. In this image, the two light cones of the camera obscura are identified, but the role of darkness is made explicit by superimposing an inversed dark cone.[56] The fading of the light is accompanied by a reinforcement of the shadows, and vice versa. In Kircher's *Oedipus Aegyptiacus*, it stands for the sphere of love, in which the World Soul infuses the whole cosmos with a ray of love. It also symbolises the relation between the angelic, sidereal and elemental worlds and the different hierarchies of being (see e.g. Kircher 1650, II, p. 450). This emblematic image, on the title page of the *Ars Magna*, again indicates the metaphysical stake of the whole work, which can be interpreted as a guidebook for the mind's sight, which 'is truly taken up to behold heavenly things, yet by shadowly sight and in a mirror' (cf. *supra*).[57]

It is striking that in the *Mystical Sphere, or the Tropologue of Light and Shadow*, the section after the epilogue in the *Ars Magna*, the ascension of the soul to God is also phrased in terms reminiscent of a camera obscura. When St. Anthony and St. Benedict 'philosophised in the

[54] See note 35.

[55] Kircher's work and context was based on authorities who were marked by the mystical tradition. Ignatius of Loyola, for instance, was himself an important 'mystic' (de Guibert, 1964, pp. 558-565), who lived in a tradition of Spanish, Jewish and Islamic mystics (de Nicolás, 1986, pp. 17-23) and had to be careful that the first Jesuits were not branded '*alumbrados*' or 'illuminists'. The mystical tendencies of Ficino and Bovillus are also well known. For the cited phrase, see e.g. John of the Cross (1964a, Stanza 13, §1; and 1964b, Stanza 2, §31). See also Rolle of Hampole (1914, p. 239) and Hilton (1991, ch. 9).

[56] The camera obscura made clear that the two ways, the emanation and the recollection, are not identical. There are different processes involved in the embodiment and disembodiment respectively. Nevertheless, they may be considered as the same path traversed in opposite directions.

[57] See also Bach (1985, pp. 209-220) and Marquet (1987, p. 236) for other interpretations of these light cones or 'pyramids'. See also Bovillus, who draws a similar image in his *Liber de Sensu* (Bovillus, 1510, pp. 23r, 29v) in order to clarify the structure of perception.

woods', they saw the whole world in one divine ray *(cf. Fig. 8)*. As we have seen, Kircher notes, all creatures are little parts of the divine light, and what else could be represented in the 'dark room of the heart' but everything in everything and everything in God. Everyone wanting to reach such a sublime state of contemplation, should shut all the windows and doors of his soul, to concentrate himself on the ray of divine light (Kircher, 1671, p. 809). Kircher's words are so lucid that it is evidently right to interpret this 'dark room of the soul' as a camera obscura, which becomes the visible symbol of the ascent to God.

Technological expressionism

I have shown that Kircher gives multiple indications to read his instruments in a religious and metaphysical way, as 'visualisations of the invisible'. In using this kind of allegory or symbolism, Kircher is a child of his time. Apart from a vogue of symbolism, however, the Jesuits had also more subtle reasons for not making certain meanings explicit. In their attempt to gain dominance in education and at court, Catholic messages should not be too overt in order to avoid provocation, and their work had to be mixed with utilitarian and entertaining aspects. But there is an even deeper reason why some religious messages cannot be made explicit: some meanings, especially religious, moral and aesthetic, cannot be expressed in an explicit way without destroying their impact. For this reason, bluntly stating that God, and the metaphysics of light and magnetism, are present at every level of the cosmos would be banal; it is a truth that only makes sense when lived through.

This is particularly clear when we look at Jesuit modes of reading and spectatorship. The Jesuits' attitude towards books, images and artefacts was significantly shaped by traditions of mnemonics and meditation. In his *Autobiography* (Ignatius, 1992, §6-7), Ignatius of Loyola describes how he used reading to fix memory points, which he then visualised in order to

imprint them into his soul. He became convinced that one should imitate and incorporate the lives of Christ and the saints. In his *Spiritual Exercises*, Ignatius formalised these techniques of reading and he selected passages from the Bible which should be visualised and meditated upon. He had also urged one of his disciples, Jerome Nadal, to illustrate these passages in order to furnish novices with an illustrated guide to meditation. This resulted in Nadal's remarkable *Evangelicae historiae imagines* (1593), with 153 engravings representing scenes from the New Testament and a legend explicating them (similar to *Fig. 8*). The images indicated the memory points and now formed, together with the legend and the short text of the *Spiritual Exercises*, the basis for meditative exercises (Nadal 1593; see also *Fig. 8* and *Fig. 11*).[58]

Jesuits often did not read or look in order to collect information; nor were they looking for aesthetic pleasure. Their reading had a different rhythm. They searched for anchor points for concentration and meditation. Their reading of texts and images was meant to stimulate the senses, memory and the imagination, in order to prepare for a particular meditative practice. After going trough the four week 'training programme' of the *Spiritual Exercises*, the scope of their spiritual practice was further extended. The Jesuit novices learned to focus on other objects, beyond religious texts and images, and 'to recognise the same spiritual affects in re-enacting the mysteries of nature' (Heelan, 1986, pp. xiii). In the end, these meditative experiences were meant to pervade their daily life. In his 'tropological rules', Kircher describes how the soul can climb to God via the contemplation of the phenomenal world. One way, he explains, is for the soul to *imitate* the characteristics of light (Kircher, 1671, pp. 808-810). In the *Ad Lectorem* of the *Ars Magna*, Kircher had already asserted that our mind will

[58] Of course, the practices of meditation discussed here have a broader context, e.g. of the *Devotio Moderna*, but the *Spiritual Exercises* was a unique handbook that formed the kernel of the Jesuit system, and the Jesuit novices were thoroughly trained in the meditative techniques included in it. For a comparison with other meditative practices in the same period, and on a possible broader use of the term 'meditation' see e.g. Hatfield (1986) (and Rubidge (1990) for a critique) and Grafton (2000). See esp. Dear (1995b) for 'meditation' in the seventeenth-century sciences, which suggests interesting parallels between scientific and religious practices. For the tradition of mnemonics, see e.g. the classic works by Yates (2001), Rossi (2000) and Carruthers (1990, pp. 156-188). On meditation on the bible and allegorese, see note 7.

ascend the different levels of being and will be united with our divine Origin, only on the basis of our contemplation of the corporeal light. This corporeal light, the visible symbol of the divine Light, is properly staged in Kircher's instruments and exemplified in the chapters of his book. These instruments, as is particularly clear in the image of the camera obscura for the ascent of the soul, will guide us to God *(cf. Fig. 9)*.

The religious reader must discover the truth of the metaphysics of light and magnetism for himself, not by reading theological tracts, but by contemplating the wondrous works of God, which Kircher compiles and complements. Kircher prepares the reader for this 'ah-ha'-experience, for the recognition of God's signs in the world. This openness for the divine signs, for the 'vestigia Trinitatis', is part of the Jesuit meditative practice and would come, ideally, to permeate every aspect of one's life. Kircher writes: '… in these things themselves, as if they were a kind of mirrors (lenses), you will see God, in the bodies you will see the shadow of God, in the souls you will see the resemblance and image of God, and in the Angels you will see His image even more perfect. […] You compile a complete figure out of the observation of all things, so that the absolute beauty of all things, which is dispersed in everything, would be collected in your mind by grasping one image.'[59]

It can be inferred from Kircher's particular metaphysics that it was compelling for him to 'embody' metaphysical truths into real instruments. Kircher's metaphysics makes clear the importance of the cosmic 'incarnation'. In Neo-Platonist and Hermetic theories the world is the embodiment or emanation of an original divine principle, and in the Christian New Testament, this process is re-staged in the doctrine of the incarnation of God. This downwards process of reification is a central element of Christian metaphysics, and is manifest in Kircher's work. Since it was the task of a Jesuit to do God's work on earth, he could partake

[59] 'Si igitur corpora, si animas, si Angelos, non haec quidem, sed in ipsis, veluti speculis quibusdam DEUM intueberis, in corporibus quidem DEI umbram, in animabus DEI similitudinem imaginemque, & longe eam in Angelis perfectiorem invenies; ita ut quicquid ubique rectum est, colligas, ex collato figuram integram ex observatione omnium fabrices, ut absoluta rerum omnium in omnibus dispersa pulchritudo in animo tuo unius fit imaginis comprehensione collecta.' (Kircher, 1654, p. 617).

in this process of embodiment. Indeed, the reification of the archetypal ideas, as explained by means of the camera obscura, could be emulated in the actual construction of the instrument, in the awareness that ideas (texts) have to be embodied (artefacts). In this way, God could express himself through his servants on earth, who could act as secondary demiurges; and while the cosmos should be interpreted as an expression of God's archetypal ideas, Kircher's instruments are to be seen as an expression of his metaphysics, of God's *eidè* and of the structure of the cosmos.

Our inter-medial approach has unearthed a very peculiar kind of 'technology' that seems completely alien today. Kircher's technologies do not fit into one simple category, and they are hardly subsumable under a straightforward functionalism, as is most clearly illustrated by those instruments or 'hoaxes' defying every natural law known today. Multiple layers of meaning were connected with the instruments at the *Collegio Romano*, and I would like to see them as *expressions* of these different meanings. As can be seen in our different examples, from the magnetic Christ to the camera obscura, many of Kircher's instruments were devised as embodiments of transcendent truths. Different meanings were mixed: these instruments were not simply made to do something; rather, their very essence was a visualisation of the hidden structures of the universe and the divine emanation. One of Kircher's 'axiomata' at the beginning of the *Ars Magna* (and derived from Plato and Maimonides) states: 'what technique is for humans, nature is for God'. Since nature and the creation are not means to an end, but an expression of God's majesty and His relation with the universe, technique will also be an expression of these concerns, such as, for instance, man's place in the cosmos. We can find signs and meanings in technical artefacts similar to the divine signs to be found in nature.

In this paper, I have stressed the expressive aspects of technology. It is in Kircher's work, with its explicit metaphysics of embodiment and emanation, that these aspects could be maximally displayed. Although Kircher's metaphysics, in which everything is a divine

'expression', seems to be untenable today, it is important to bring the expressive potentials of technology again to the fore.[60]

By way of conclusion: the meaning and utility of artefacts

This essay was a search for the different 'meanings' (or 'uses') of Kircher's devices. I have analysed different texts and illustrations related with his artefacts, and indicated the practices in which they were used. His instruments carried 'scientific', political, social and apostolic meanings, as well as meanings related with entertainment, spectacles and courtly culture. I argued, however, that it is particularly important to interpret Kircher's artefacts in their metaphysical framework, since metaphysics (and the related theology) took central place in Kircher's worldview.[61] According to Kircher, God is the source of all meaning. This meaning was diversified, radiated and emanated into the world, and all meaning has – in the end – to be referred back to God. The bearing of the relation between Kircher's instruments and metaphysics is especially clear in the epilogue of the *Ars Magna*, where Kircher phrased his metaphysics in exactly the terms used for describing a camera obscura. This made it possible for me to describe the representation of his artefacts in his texts, and vice versa, to describe the representation of his texts in his artefacts. Both these interpretative moves were necessary for understanding the meaning of some of Kircher's 'textual' and 'actual' artefacts. In performing this 'double way' exercise, I have also tried to show the promises of integrating the history of material culture with the history of texts and ideas.

After the early-modern period rhetoric of 'utility', instruments were almost exclusively seen in the light of a narrow economic and technical concept of 'utility'. Historically, the 'use' of

[60] I think that contemporary philosophies of technology do not sufficiently recognise the diversity of practices in which artefacts are used today. Indeed, I think that there are prospects for an 'expressionism' in technology studies.

[61] Note, however, that I do not claim to provide an ultimate interpretative key for Kircher's work.

artefacts is much more diverse, however, as the example of Kircher's instruments shows. Different modes of using, which incorporate ways of reading and kinds of spectatorship, generate a diversity of meanings. I have argued that Kircher's artefacts and texts were embedded in a Jesuit context, characterised by meditative practices and particular modes of reading and spectatorship, but they also fulfilled a crucial role in his patronage relationships and were part of a 'spectacular' culture. Uses or practices interact with each other, and instruments can be used in different practices, sometimes even simultaneously, and there is no reason to suppose that they have the same meaning for everyone. Often, the form and design of an artefact are underdetermined by its primary function. In that case, there is ample opportunity for artefacts to become nodal-points of different meanings, uses and practices, and they may be said to 'express' these meanings. Kircher's clocks, for instance, were at once measuring instruments and representations of political and metaphysical meanings. From the above analysis of Kircher's instruments, it is clear that artefacts can be used in many ways, even within one overarching practice.

Books are artefacts too. When they are transposed to a new environment, new meanings are generated while the old ones fade away.[62] As material objects, they can be revised by editors, parts can be cut out, and patched up collections can be reissued. In later editions of Kircher's notes, in new collections compiled from particular segments of his oeuvre, and in the later descriptions of his museum, the metaphysics was left out, in favour of the entertainment value and the display of technical virtuosity.[63] The modes of reading corresponding to later rationalist and Enlightenment ideologies also neglected the religious and metaphysical components of Kircher's work, only focussing on the allegedly new inventions and

[62] On the history of the book in relation to the history of the sciences, see Johns (1998) and Frasca-Spada & Jardine (2000).

[63] Cf. De Sepibus (1678), Kestler (1680), Buonanni (1709), de Ruggiero (1878), de Ruggiero (1879), as well as adaptations and appropriations of Kircher's work in Schott (1657), Schott (1660) and Schott (1667). Later works, such as de Contucci (1763-5), Brunati (1837) and Paribeni (1904) deal only with antiquarian material found in what was left from the Kircherian museum.

instruments. In this way, Kircher's metaphysics and the metaphysical importance of his instruments disappeared.

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Fig. 1: Thesis broadsheet commissioned by Lorenzo Raggi, who defended in philosophy at the *Collegio Romano* in 1637. It was dedicated to Cardinal Francesco Barberini and the fictive tapestry at the centre represents the abundance of the Golden Age. The bees are symbols of both the Barberini family and the Jesuits. From Rice (1999, p. 157). The visual appearance of this broadsheet, and especially its text-image relationship, somewhat resembles Jesuit devotional books (*Fig. 8*). © University of Toronto Press.

Fig. 2: Kircher (1671, p. 127). Woodcut of a perspective device. The instrument is rendered schematically and in a very abstract way. It was not really meant to be used, but served to illustrate the theory of perspective. Here, Alberti's 'construzione legittima' is shown. Similar devices were well known, and the most famous illustration of them is probably Dürer's 'draftsman drawing a nude', a realistic woodcut published in *Unterweysung der Messung* (1538). This and all the following figures in this paper, if no other acknowledgement is given: © Library of Theology, Leuven University.

Fig. 3: Kircher (1671, p. 364). A complex sundial, in the form of a heraldic eagle, floating (flying?) in the foreground of a detailed landscape. The eagle, symbol of the Habsburg Roman Empire, is flanked by emperor Ferdinand's name, which is also devised as a sundial. The contrast between the naturalistic landscape and the awkwardly placed (but also naturalistically executed) instrument gives the picture its particular effect, and strengthens its symbolic character. Not only the devise is symbolical, the placing of the sundial also symbolises the power of the emperor, spanning land, see and air, and of course time, aided by the (divine) light.

Fig. 4: Kircher (1671, p. 770). The ‘Parastatic Smicroscope’, an instrument used for showing (religious) pictures. Here 8 stages of the Passion of Christ are shown. The instrument is naturalistically drawn, but is cast in an abstract white background. Different sides are shown, and an objectified bodiless eye looks through the tube to illustrate its use. This ‘abstraction’ is a bid for authority and indicates the instrument’s mathematical pretensions. Only by means of the images, the religious context is sneaked in again. (‘Smicroscope’ and ‘microscope’ are in fact synonymous in Greek, but this instrument does not resemble the better known microscopes).

Fig. 5: Frontispiece of Kircher’s (1671) *Ars Magna*, engraved by Petrus Miotte of Burgundy. This frontispiece visualises what is at the stake in the *Ars Magna*. God, the source of the divine light, radiates downwards from the archetypal world to the sublunar world, connecting everything in between. All elements of this image are loaded with symbolic meanings.

Fig. 6: Frontispiece of Kircher’s (1654) *Magnes*, composed by I.B. Rinalducius. This frontispiece is lacking in some copies of the first and second editions, sometimes it was added as the frontispiece of the third book of the volume. The outer part of the picture was added in the latest edition (obscuring the names of the original artist, engraver and publisher), in order to adapt the picture to the new folio format of the book. Magnetic chains connect the whole of the universe. The diverse ‘sciences’ are coupled to the three worlds – the sideral, sublunar and the microcosm – which in their turn touch (emanate from) the divine rays of the archetypal world at the centre. A divine eagle, with the symbols of justice and law-giving power, holds the whole structure in his claws.

Fig. 7: Kircher (1654, p. 297). The magnetic dip (termed ‘inclination’ by Kircher and ‘declination’ by Gilbert) was the deviation of a compass needle from the horizontal plane. Kircher believed, as did Gilbert and Cabeo, that this deviation was a function of the degree of latitude. They thought that when the magnetic dip was measured at a certain place (by means of an ‘inclinometer’, depicted and described in Kircher, 1654, pp. 307-311), it was possible to determine the latitude of this place. Figure 7 is a mathematical instrument for deriving the magnetic dip, given the degree of latitude, and vice versa. In order for the instrument to work, a moving quadrant should be attached in point E (this can be found in some copies of the *Magnes*). The instrument bears the inscription: ‘Just as the magnet slopes towards a single centre, even so does our heart point inwards towards God.’ This shows that real instruments often had symbolical meanings as well.

Fig. 8: David (1610, p. 96). Narrative image from a Jesuit devotional book, making clear that we can see God in natural phenomena as well as in a mirror. At the centre, two people see God through a mirror. The corresponding caption for this part of the figure (ABC) reads: ‘contemplating the invisible through the visible’. This corresponds well with Kircher’s approach to mirrors in the *Ars Magna* and the *Magnes*. In the background, at the left, one sees Jacob’s ladder (D), a traditional image of the bridge between heaven and earth (Gen. 28: 10-22). Job stands in front of this ladder (F), which guides us via the created world towards the celestial secrets (D). In the caption F, one is urged to meditate on how far Job has ascended the ladder by considering the works of God (cf. Job: 23). At the right, Saint Bernardus is in the woods contemplating God (E). In the middle section of the picture, someone looks at the lilies in the field and the birds in the sky, while a woman inspects the heavenly acre (GH).

Fig. 9: Kircher (1671, p. 84). A schematic visualisation of what happens with light rays when they pass through a small hole. This woodcut, taken from the chapter on radiation, in which Kircher discusses the principle of the camera obscura, fits in well with his metaphysical discussion of the descent and ascent of ideas.

Fig. 10: Kircher (1671, title page) Emblematic picture on the title page of Kircher's Ars Magna. This emblem of intersecting dark and light pyramids is richly-laden with meaning. It depicts the relation (and intertwining) of the higher principles with the lower, which can be expressed in different ways. In the *Ars Magna Lucis et Umbrae*, it represents the interaction between the realm of the light and the realm of shadows.

Fig 11: Image from a devotional emblem book (de Montenay, 1584, p. 5). Here, the image of the magnet is used as a starting point for contemplating divine attraction. The corresponding caption reads: 'The iron is attracted by a magnetic power; and we are drawn to Christ by the merciful God. Therefore do not expect to live by your own power: but recognise your life as a gift granted to you by God.'